V Semester

MICROPROCESSOR & MICROCONTROLLER

Course Code:	21ECU502	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:2:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:

i. To illustrate the architecture of 8051 Micro controller.

ii. To understand the Special Function Registers, addressing modes and memory organization.

iii. To introduce Assembly language programming of 8051 Micro controller.

iv. To understand the RISC V microprocessors and Instruction Set Architecture.

Module-1	**08 hrs**

Introduction to microprocessors and microcontrollers: RISC & CISC CPU Architectures, Harvard & Von- Neumann CPU architecture.

8051 Microcontroller: The 8051 Architecture, Pin diagram of 8051, Memory organization, External Memory interfacing. Classification of Instruction, Addressing modes: Immediate addressing, Register addressing, Direct addressing, Indirect addressing, relative addressing, Absolute addressing, bit direct addressing. **(TEXT 1 and TEXT 2)**

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, l3

Module-2	**07 hrs**

8051 Instructions and Programming: 8051 instructions, Data transfer instructions,Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instructions. 8051 programming: Assembler directives, Assembly language programs and Time delay calculations. Stack operations.

Introduction to Embedded C: C data types, logical operations, programming 8051 using embedded C

(**TEXT 2 and TEXT 3**)

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-3	**09 hrs**

Timers/counters: 8051 timers/counters, delay program, counter programming 8051 timers to generate delay and counting operation using assembly and C language. Data communication, Basics of Serial Data Communication, 8051 Serial Communication, Programming in assembly and C.

Serial Communication: Data communication, Basics of Serial Data Communication, 8051 Serial Communication, Programming in assembly and C.

8051 interrupts and interfacing: Interrupts and Basics of interrupts, 8051 Interfacing and Applications: Basics of I/O concepts, I/O Port Operation, Interfacing 8051 to DAC,LED/LCD. **(TEXT 3)**

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

RISC-V Microprocessors: Introduction, Modular vs. Incremental ISAs, ISA Design 101

RV32I: RISC-V Base Integer ISA: Introduction, RV32I Instruction formats, RV32I Registers, RV32I Integer Computation, RV32I Loads and Stores, RV32I Conditional Branch, RV32I Unconditional Jump, RV32I Miscellaneous, Comparing RV32I, ARM-32, MIPS-32, and x86-32 using Insertion
Sort.

RISC-V Assembly Language: Introduction, Calling convention, Assembly, Linker, Static vs. Dynamic Linking, Loader.

Teaching Learning Method:	Chalk and Talk, Power point presentations, Programming assignments
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

RV32M: Multiply and Divide- Introduction

RV32F and RV32D: Single- and Double-Precision Floating Point- Introduction, Floating-Point Registers, Floating-Point Loads, Stores, and Arithmetic, Floating-Point Converts and Moves, Miscellaneous Floating-Point Instructions, Comparing RV32FD, ARM-32, MIPS-32, and x86-32 using DAXPY.

RV32C: Compressed Instructions- Introduction, **RV32A: Atomic Instructions-** Introduction, **RV32V: Vector**- Introduction

Teaching Learning Method:	Chalk and Talk, Power point presentations, Programming assignments
RBT Level:	L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool

Sl. No.	Experiments	12 hrs
1	**Data transfer programs-** **i]** WALP to transfer data between internal and external memories **ii]** WALP to exchange data between internal and external memories	
2	**Arithmetic operation programs-** **i]** WALP to add 10 bytes of data **ii]** WALP to add multi bytes of data **iii]** WALP to find the square and cube of an 8 bit binary number	
3	**Logical operation programs-** **i]** Let X, Y, Z refer to the contents of the memory location 30h,31h,and 32h respectively, write an ALP to perform the following logical operations; If X=00 perform the operation Y OR Z. If X=01 perform the operation Y AND Z. If X=02 perform the operation Y XOR Z. **ii]** WALP to compare the bytes of data present at the memory location 21h and 22h and represent the result of comparison through the bits whose addresses are 00h and 01h. If (21h)<(22h)then clear the bit at 01h and also set the bit at 00h. If (21h)>(22h)then set the bit at 01h and also clear the bit at 00h. If (21h)=(22h)then set the bit at 01h and also set the bit at 00h. **iii]** WALP to stimulate the Boolean expression **Eg:** Y=A+BC.	

4	i] **Parity Program-** WALP to count the number of 1’s in a byte which is be accepted from the port 0 and displays the result on the port1. **ii] Palindrome Program-** WALP to check whether the gives byte is a valid bit palindrome,accep byte from the port0 and display aah if valid else 00H in port1.
5	**Timer program-** WALP to generate the output value AAH and 55H alternatively at the Port 0 for every 2 sec.
6	**Counter program-** WALP to count the number of inputs to the counter_0 by configuring the timer as a counter in mode_1 and display the count in ports.
7	**Design and implementation of RISC V Processor Subsystem using Verilog:** a) Floating Point Addition & Subtraction. b) Floating Point Multiplication. c) Operand Logic.

Demonstration Experiments (For CIE only not for SEE)

Conduct the following experiments on an 8051 MC using evaluation version of Embedded 'C' & Keil µvision-3 tool/compiler.

08	**Demonstrate the serial communication-**WALP to transfer the characters serially.
09	**Demonstrate the interfacing of DAC programs-**WALP to generate the wave forms i] Square wave ii] Triangle wave **iii]** Ramp wave (Both positive and negative)
10	**Demonstrate the interfacing of LED programs**- WALP to display the count (UP/DOWN/LED BLINKING)

Course outcomes:

At the end of the course the student will be able to:

CO1: understand the features and architecture of 8051 Microcontroller.

CO2: program 8051 microcontroller using assembly language and embedded C.

CO3: configure timers/counters of 8051 and understand serial communication and interrupts of 8051.

CO4: understand need of RISC V microprocessors and basics of RV32I.

CO5: understand basics of RV32M, RV32F, RV32D, RV32C, RV32A, RV32V.

Suggested Learning Resources:

Text Books:

1. **Yu-cheng Liu, Glenn A.Gibson,** “Microcomputer Systems: The 8086/8088 Family Architecture, Programming, and Design”
2. **Kenneth J. Ayala,** “The 8051 Microcontroller Architecture, Programming & Applications”, 2e Penram International, 1996 / Thomson Learning 2005.
3. **Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay,** “The 8051 Microcontroller and Embedded Systems – using assembly and C”, PHI, 2006 / Pearson, 2006.
4. **The RISC-V Reader: An Open Architecture** Atlas Beta Edition, 0.0.1, David Patterson and Andrew Waterman, October 4, 2017

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2	2	2				2	1	3	1
CO2	3	3	3			2		2	1			2	1	3	1
CO3	3	3	3		3	2		2	1			2	1	3	1
CO4	3	2	3		3	2		2	1			2	1	3	1
CO5	3	2	2		2	2		2	1				1	3	1

High-3, Medium-2, Low-1